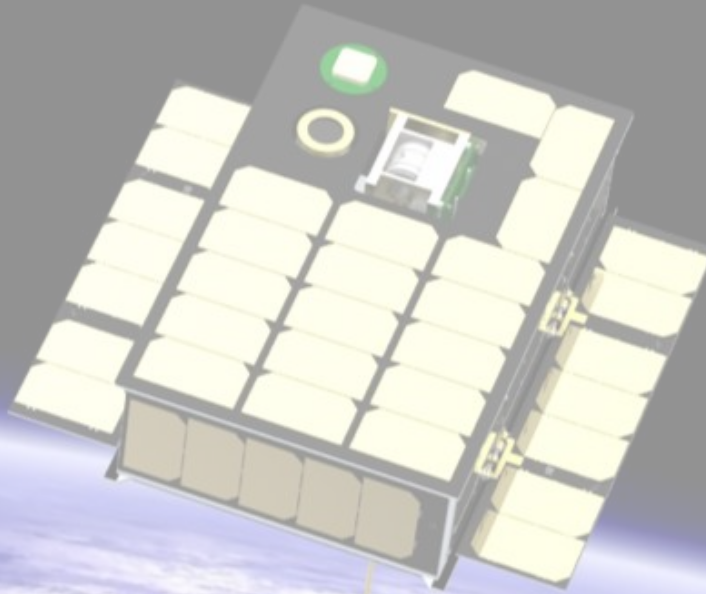


# BurstCube

A CubeSat for  
Gravitational Wave  
Counterparts



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See ICRC 2017 Proceedings for More Details: <https://pos.sissa.it/301/760/>  
Website: <https://asd.gsfc.nasa.gov/burstcube/>

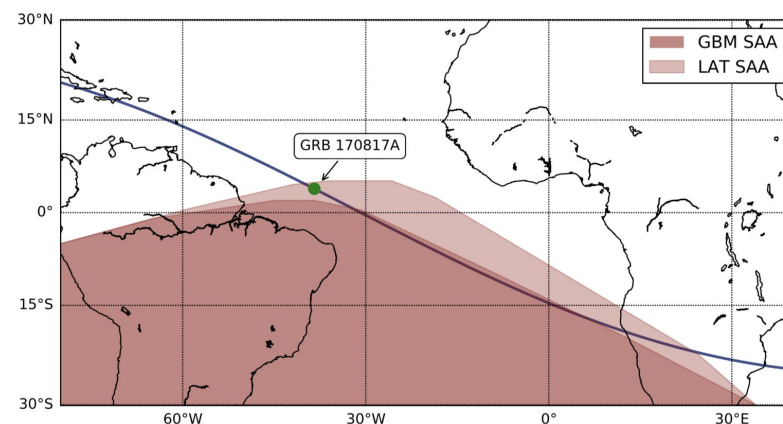
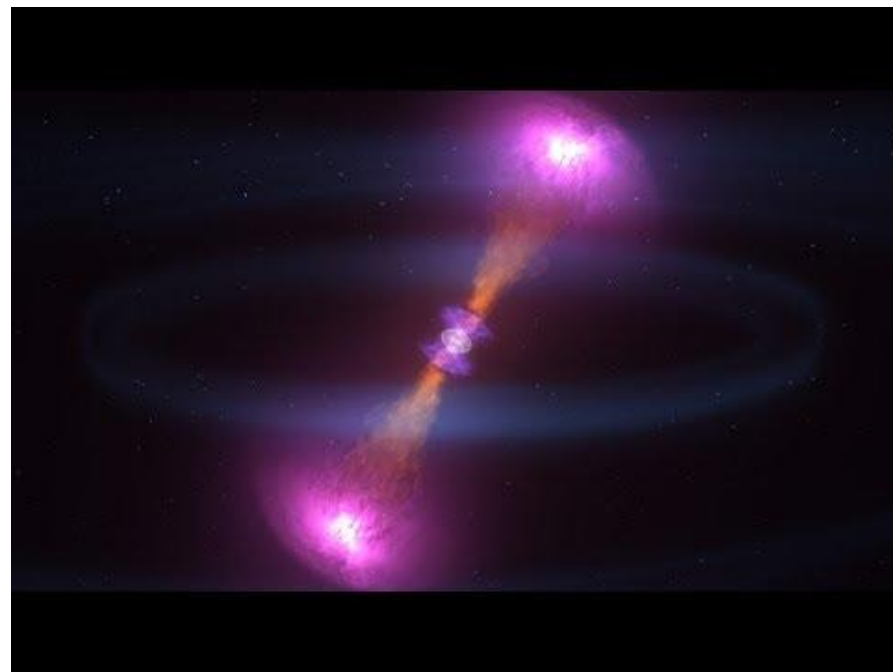
# Grand Overview of BurstCube



- BurstCube: a **6U CubeSat** that will **detect and localize** Gamma-ray Bursts (GRBs):
  - Focus on **short GRBs** (sGRBs; binary neutron star mergers) that are the counterparts of gravitational wave (GW) sources.
- Will detect these with **four CsI** scintillators coupled with arrays of compact low-power **Silicon photomultipliers** (SiPMs).
- Spacecraft based on NASA/GSFCs Dellinger platform with many components sources commercially-off-the-shelf (COTS).
- Complement existing facilities (*Swift*, *Fermi*) and could be an **interim GRB instrument** before next generation missions fly.
- BurstCube **will fly in 2021**.
- The ultimate configuration of BurstCube would be **a set of ~5 CubeSats** providing all-sky coverage for a very low cost.

# BurstCube Science

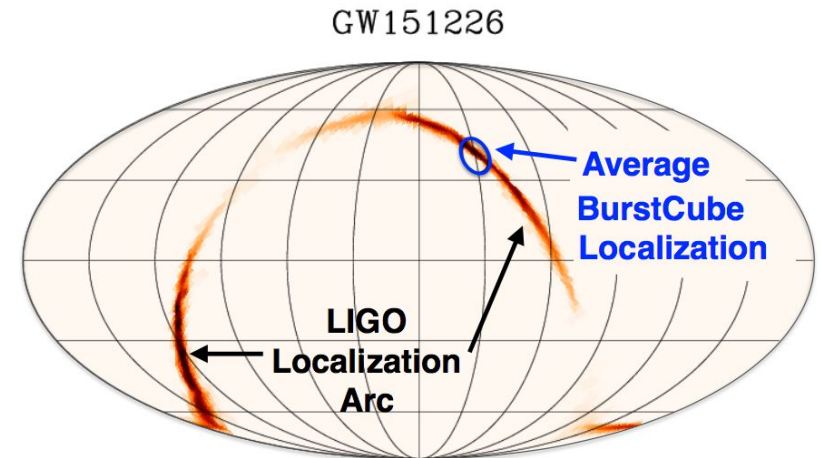
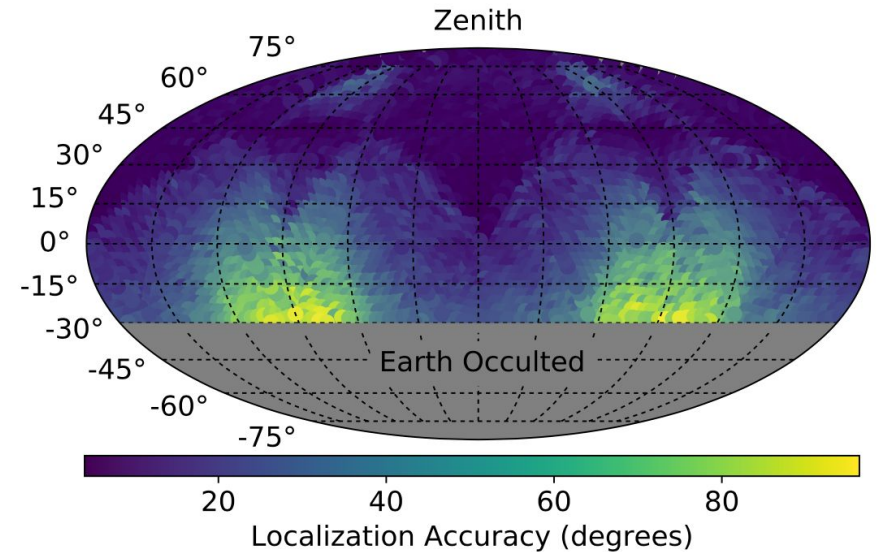
- BurstCube will **increase the sky coverage** for short ( $<2$  s) GRBs, especially important in the current era of GW discoveries.
- **New GW detectors** are coming online between now and 2021.
- The recent coincident detection of a sGRB (by *Fermi* and other multiwavelength partners) and a GW trigger has provided **concrete proof** that at least some sGRBs are produced by BNS mergers.



# BurstCube Science

Provide localizations:

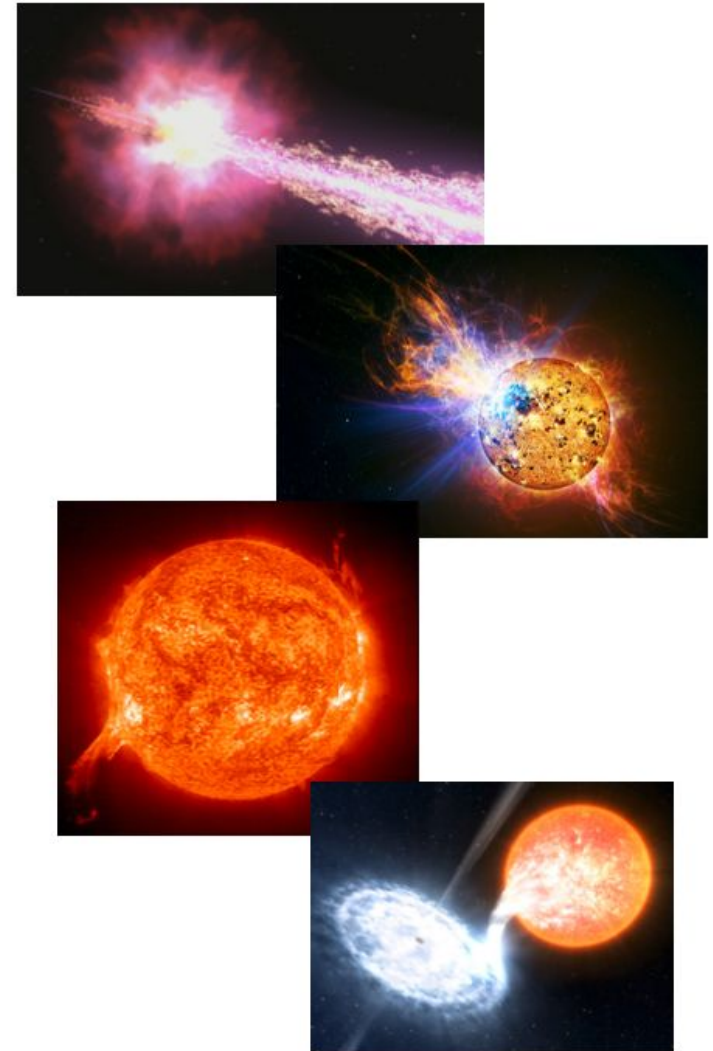
- **Assist wide-field follow-up** observers in afterglow detection and redshift measurement.
- Will lead to:
  - Additional insight into **cosmological parameter estimation**,
  - Constraint on the neutron star **equation of state**, and
  - An inventory of **r-process elements** in the Universe constrained by the faint short GRB kilonova signature (seen in the most recent event).





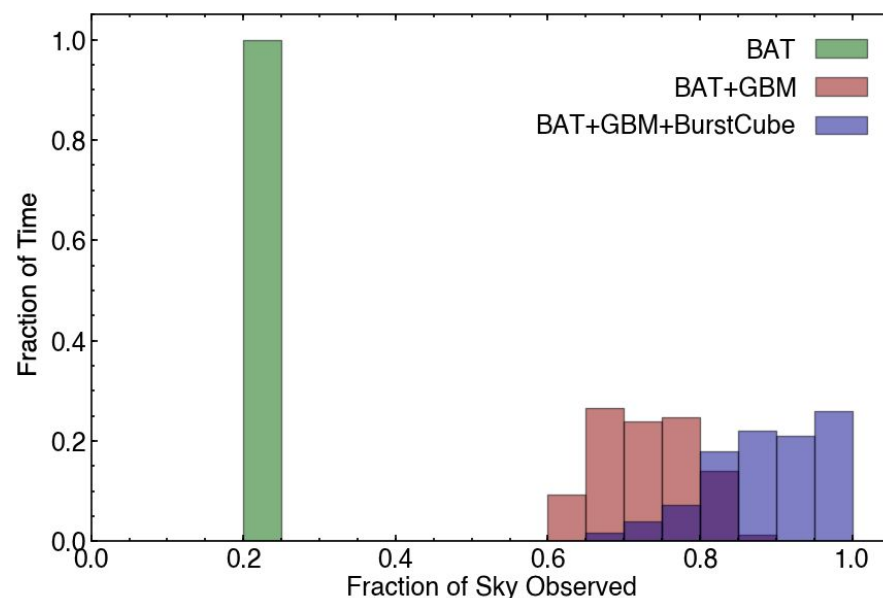
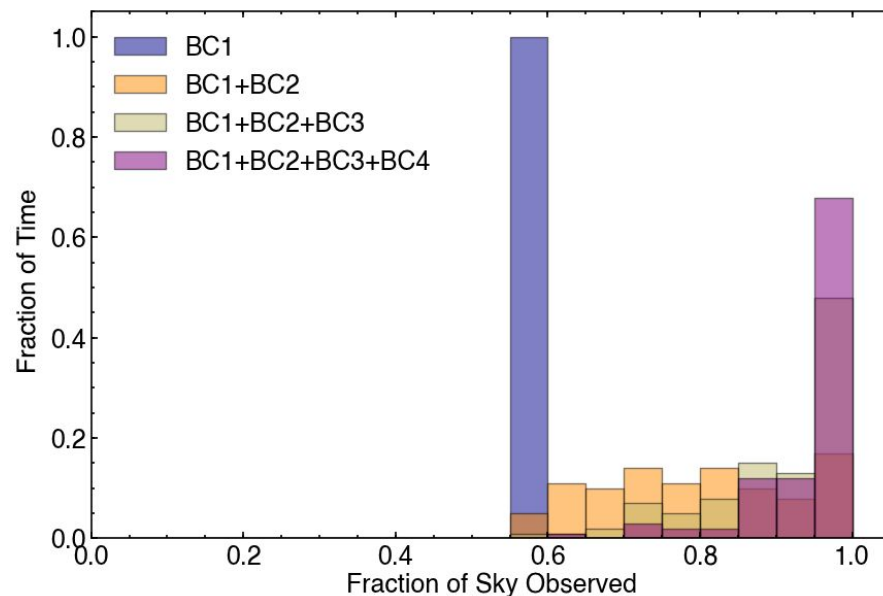
# BurstCube Science

- BurstCube will detect GRBs (long and short) from the **entire unocculted sky**
  - Providing broadband spectra for burst detected elsewhere
  - Rough localization for follow-up
  - Accurately timed light curves
- BurstCube will also detect **solar flares, magnetar flares, and other hard X-ray transients**, as well as persistent sources via occultation analysis
- BurstCube is **complementary to current instruments** but in a future without other GRB triggering instruments, BurstCube could provide all-sky coverage for a small fraction of the cost of an Explorer.



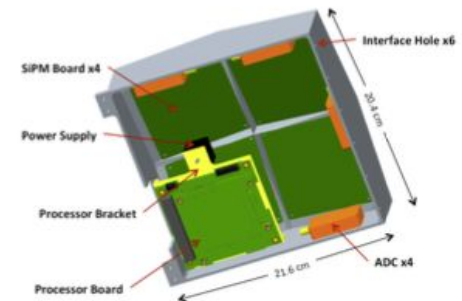
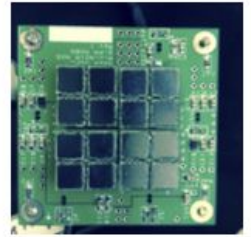
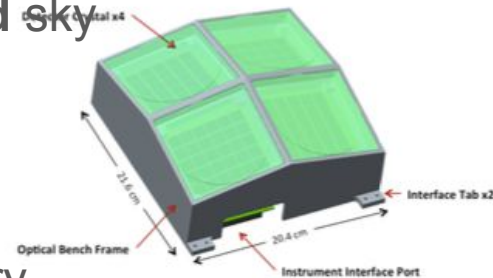
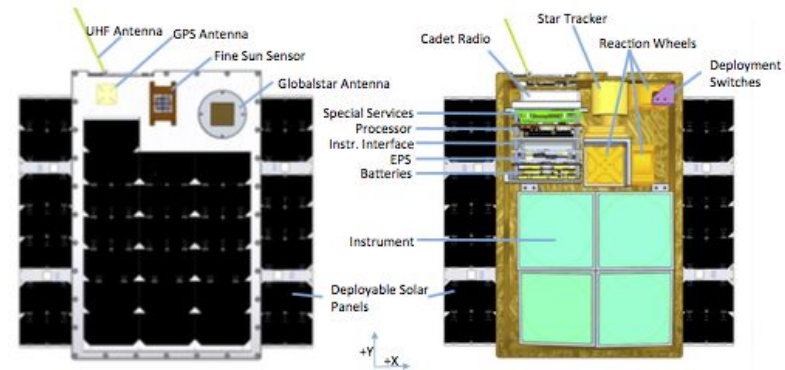
# Mission Concept

- For a **small fraction** of the cost of an explorer mission, BurstCube will
  - **Detect, Roughly Localize, and Characterize** GRBs
- This approach is **complementary** to existing or upcoming facilities (e.g. Swift, Fermi, SVOM)
  - Especially if there is a gap between GRB missions operating at the peak of the GW observatory operations.



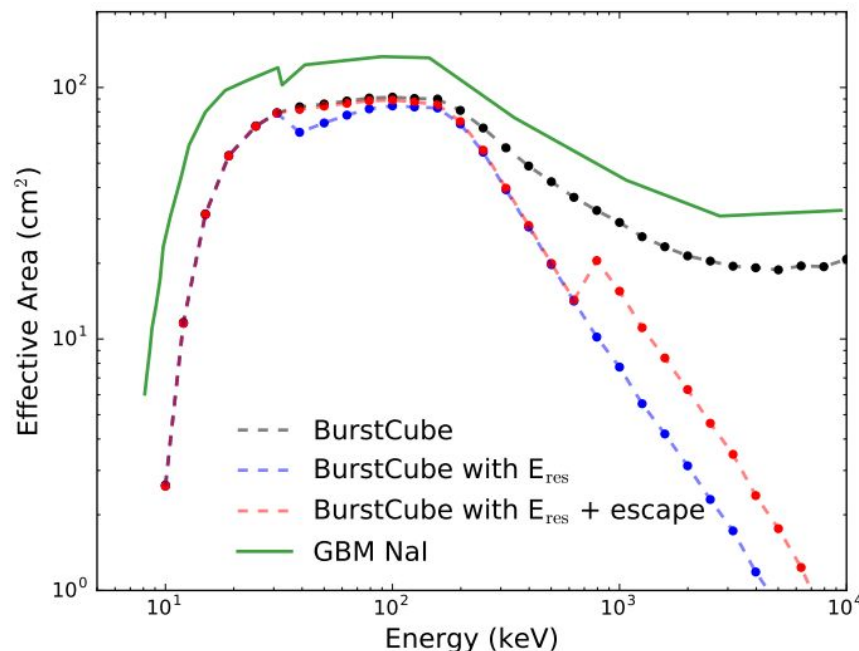
# Mission Implementation

- BurstCube is a **6U CubeSat** that includes
  - Deployable Solar Panels
  - Full ACS System
- Instrument Package
  - **4 Csl scintillator** crystals coupled to arrays of **low-power** Silicon Photomultipliers (SiPMs) with custom electronics
  - **Localizes GRBs** based on relative intensities in each detector.
- BurstCube will observe the **full un-occulted sky** by zenith pointing, recording gamma-ray photons, and triggering on significant rate fluctuations.
- BurstCube will relay data to the ground every **2-12 hours**.
- Trigger data will be **immediately transferred** to the ground via the GlobalStar network or TDRS (TBD).
- The instrument hardware and flight and ground software design **relies heavily upon heritage** from Fermi-GBM.



# Mission Performance

- Continuous Science Operations
- Detect **~24 sGRBs/year**
  - Including **~1 coincident** sGRB-GW/yr
  - Large increase from not having BurstCube
- Detect **> 100 long GRBs/yr** in addition to other gamma-ray transients (solar flares, SGRs, etc.)
  - Will result in a significant increase in statistics.
- BurstCube has competitive performance with *Fermi*-GBM



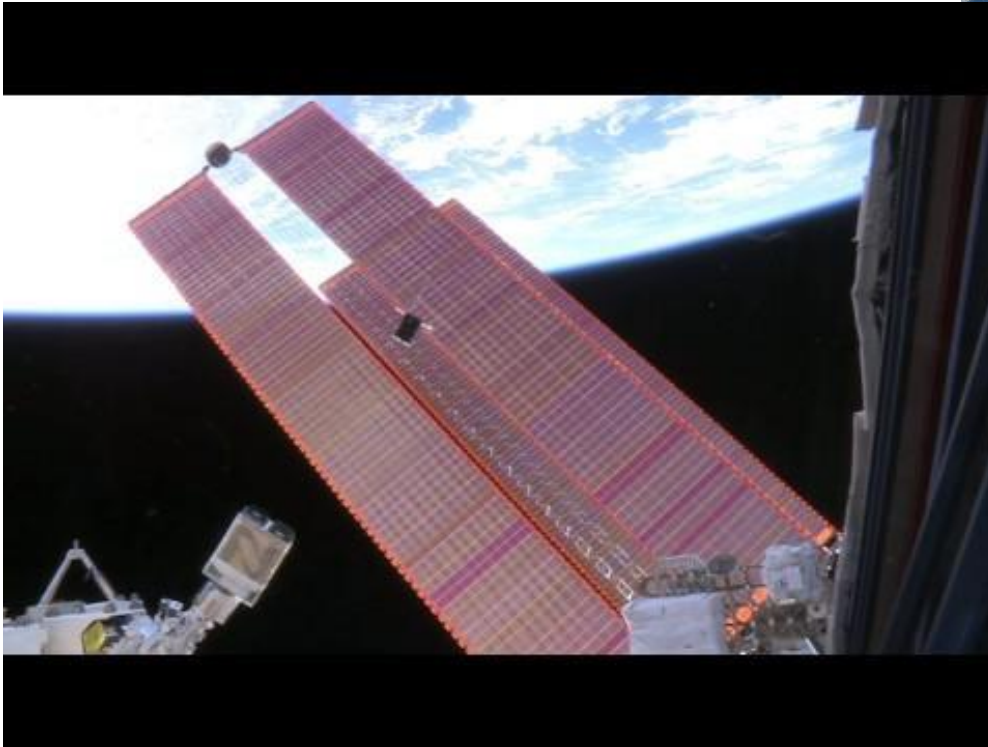
Effective area is 67% that of the larger GBM NaI detectors at 100 keV and 15 degree incidence (MEGALib based sims)



# Updates: Dellingr Deployment



Courtesy: Dellingr Team



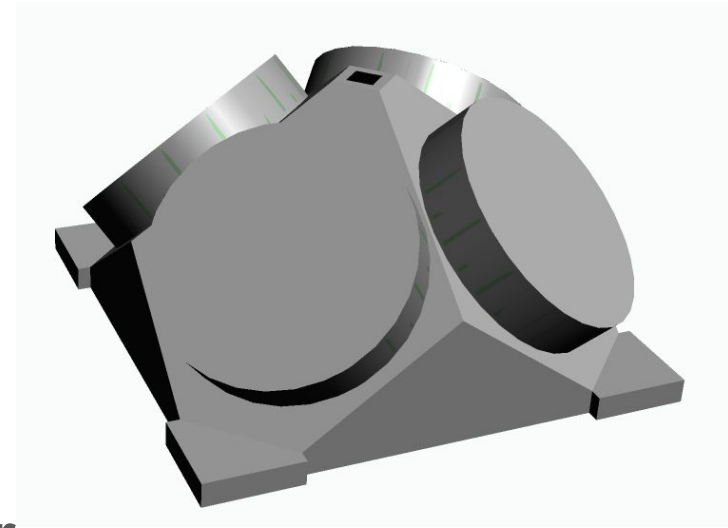
Courtesy: Dellingr Team

## Dellingr FlatSat Development:

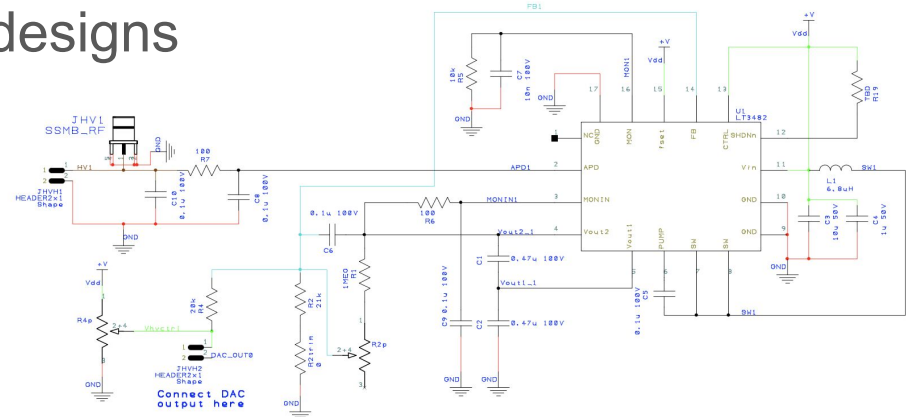
- Dellingr team is beginning to test S-band radio on the FlatSat.
- Goal is to use this radio on BurstCube with TDRS

# Updates: Instrument Design

- Received funding to begin a slow ramp up of the project
- Preliminary Design is underway for the instrument
  - Mechanical
  - Electrical
- Testing current SiPM array designs



Programmable SiPM Bias



# Gratuitous Recruitment Slide

Looking for a postdoc:

- [http://cresst2.umd.edu/opportunities/BurstCube\\_Postdoc\\_Final.pdf](http://cresst2.umd.edu/opportunities/BurstCube_Postdoc_Final.pdf)
- <https://npp.usra.edu/opportunities/details/?ro=19135>

Looking for interns:

- <https://intern.nasa.gov/ossi/web/public/guest/searchOpps/index.cfm?solarAction=view&id=29414>

Looking for a graduate student:

- Contact one of us: [jeremy.s.perkins@nasa.gov](mailto:jeremy.s.perkins@nasa.gov), [judith.racusin@nasa.gov](mailto:judith.racusin@nasa.gov), [georgia.a.denolfo@nasa.gov](mailto:georgia.a.denolfo@nasa.gov)